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EVALUATION OF THE NANOSCALE HEAT AND MASS TRANSFER MODEL OF LII: PREDICTION OF THE EXCITATION INTENSITY

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ABSTRACT

The current mathematical model developed for the heat and mass transfer processes of laser-induced incandescence (LII) was evaluated in terms of the excitation profile, which relates the prompt LII signal to the laser fluence. The model prediction for the excitation profile is compared with experimental data for both uniform and Gaussian spatial laser intensity distributions. Use of E(m) based on the accepted soot refractive index established by Dalzell and Sarofim for calculation of laser energy absorption by soot results in a much sharper rise of the excitation profile compared to the experimental data. Better overall agreement between the predicted excitation curve and the experimental one was obtained by using the value of E(m) based on the soot refractive index established by Lee and Tien. The predicted excitation profile of the prompt LII signal is more sensitive to uncertainties in the value of E(m) than to the initial particle size and the detection gate width and timing. The temporal profile of the pulsed laser intensity has a much less effect on the excitation curve than the spatial profile of the laser but significantly affects the history of soot temperature and diameter.